

## INTEGRATED INTAKE MANIFOLD AND HEAT EXCHANGER

### Related Applications

This application is related to and claims priority to U.S. Provisional Patent Application  
5 No. 60/450,103, filed on February 25, 2003, the entire disclosure of which is hereby incorporated  
by reference.

This application is also related to and claims priority to German Patent Application No.  
102 35 190.2, filed on July 26, 2002, the entire disclosure of which is hereby incorporated by  
reference.

### Field of the Invention

10 The present invention relates generally to integrating a heat exchanger with an intake  
manifold. More particularly, the present invention relates to an intake manifold connected to a  
heat exchanger for an internal combustion engine for marine applications.

### Background of the Invention

15 With internal combustion engines, the waste heat developed in the engine must be  
reliably transferred to the surroundings under all conditions via suitable cooling means. With  
internal combustion engines for marine applications, especially internal combustion engines for  
watercraft, boats or recreational sporting equipment such as personal watercraft, cooling takes  
place either directly through the ocean/lake water in an open-loop cooling circuit, or through a  
20 closed-loop cooling circuit with a cooling agent/ocean water heat exchanger. For known internal  
combustion engines with closed loop cooling circuits, the heat exchanger is mounted to the  
chassis or hull.

### **Summary of the Invention**

According to the invention, the heat exchanger is no longer tightly attached to the boat, but to the engine. For this design, the invention provides for a holding fixture useful for supporting a heat exchanger attached to, or integrated with, an intake manifold of an internal  
5 combustion engine.

Thus, according to the invention, the heat exchanger is attached directly to the air intake manifold of the internal combustion engine. This is advantageous because previously required additional holders are no longer necessary and an additional interface between engine and boat, with costly hosing and line arrangement, is avoided.

10 By preference, the intake manifold subject to the invention has a holding device to support the heat exchanger. This design allows the holding device to be formed as a single piece with the intake manifold, minimizing the assembly effort.

To achieve best possible seating of the heat exchanger in the holding device of the intake manifold, the holding device, in accordance with the design of the invention, has a support with  
15 its form adapted to that of the heat exchanger for positive-locking of the heat exchanger in the holding device. To reduce vibrations, vibration-damping elements can be included in the holding device.

As a further particular design advantage of the invention, the holding device of the intake manifold subject to the invention is, at the same time, also shaped as a support element to  
20 support the intake manifold on an engine block of the internal combustion engine. Thus, the holding device fulfills the additional purpose of a support for the intake manifold against the engine block. This design increases the stability of the engine layout and suppresses vibrations. As a design advantage, the holding device is fitted with reinforcement fins.

### **Description of the Drawings**

Figure 1 is a perspective view of the intake manifold and heat exchanger emphasizing the capacity buffer and heat exchanger.

Figure 2 is a perspective view of the intake manifold and heat exchanger emphasizing the  
5 holding device.

Figure 3 is a different perspective view of the intake manifold and heat exchanger emphasizing the holding device.

### **Detailed Description**

The invention provides for an intake manifold 10 for an internal combustion engine,  
10 characterized by a heat exchanger 50 that is connected to the intake manifold 10, and an internal combustion engine for marine applications with the heat exchanger 50 connected to the intake manifold 10. The intake manifold 10 of an internal combustion engine may be characterized by a holding fixture 30 to support the heat exchanger 50. The holding fixture 30 may be formed as a single piece with the intake manifold 10. In order to achieve a form-fit support of the heat  
15 exchanger 50 in the holding fixture 30, the contours of the holding fixture 36, 38 may be adapted to the shape of the heat exchanger 50. Concurrently, the holding fixture 30 may be formed as a supporting element 46 for support of the intake manifold 10 to an engine block of the internal combustion engine.

As an example version of the invention, Figure 1 schematically represents the intake  
20 manifold 10 with a capacity buffer 12, from which two curved suction arms 14 project upwards as shown in Figure 1. On the ends facing away from the intake plenum or capacity buffer 12, the intake runners or passages 14 are fitted with flanges 16 for connection of the intake manifold 10 to an engine (not shown). Located on the capacity buffer 12 between the two suction arms 14 is

an opening with a flange 18 used for connection of a (not shown) throttle unit. Further provided on the capacity buffer 12, are openings and flanges 20, 22, which are intended for a pressure connection and the connection of a temperature sensor.

Below the capacity buffer 12 of the intake manifold 10, the holding device 30 subject to the invention projects off of the capacity buffer 12, which is preferably shaped as a single unit with the intake manifold 10, as shown in Figure 2.

The base corpus 32 of the holding device 30 consists primarily of two side walls 34 that face downward from the capacity buffer 12 and generally have a C-shaped base surface. In the upper and lower section of the C-shape on the side walls 34 are concave surfaces that form the seat 36, 38 for a primarily cylinder-shaped heat exchanger 50. The concave surfaces within the area from the C-ends of the holding device 30 can be formed separately as in Figure 3, or connected with each other as in Figure 2. Additionally, the holding device 30 is fitted with several reinforcement fins 40 to increase stability.

For attachment of the heat exchanger 50 in the seat 36, 38 of the holding fixture 30, straps as well as clamps 42 are provided for as shown in Figure 1. In order to reduce vibrations, rubber matting or rubber straps 44 can be placed under the attachment clamps 42 as indicated in Figure 1. In the same manner, the concave surfaces of the seat 36, 38 can be laid out with rubber linings.

On the side facing away from the heat exchanger 50, the holding device 30, according to the invention, is designed to be supported against an engine block of the (not shown) internal combustion engine. For this purpose, the edges 46 from the side walls 34 of the holding device 30 pointing away from the heat exchanger 50 as well as the struts 48 arranged in between are

adapted in their form so that a positive form-fit is achieved. At its lowest point, the holding device 30 is fitted with a bore 49, which is used to bolt it together with the engine block.

The heat exchanger 50 has similar connections 52, 54 for intake and outlet of ocean/lake water, as well as connections 56, 58 for intake and outlet of cooling agent.